Breaking the habit: Does fracturing your wrist change your travel and driver behaviour?

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Abstract

When someone breaks their wrist it presents a disruption to everyday routine. Some of this is as a result of having to change travel patterns. This paper investigates the changes people make to their travel behaviour in the light of an unexpected change in their situation caused by fracturing their wrist and wearing a forearm plaster cast. One hundred and eleven participants, approached as they were having their plaster cast removed, completed a questionnaire addressing travel behaviour change, driver safety and information provision covering their time in a plaster cast (typically an average of 5-6 weeks). Eighteen percent of participants drove during the time they had a forearm plaster cast on. All reported they felt safe in doing so and that wearing the plaster cast did not compromise safety, though it was uncomfortable and compensatory behaviours took place. Risk and affective scales did not predict whether participants drove in a cast, suggesting that practical and utilitarian, rather than psychosocial, reasons were the motivation for driving in a plaster cast. Eighty-two percent found other ways of travelling without using their car. Participant's use of buses and trains, walking and taking lifts were all increased and overall, across all modes of transport, participants travelled fewer miles but made more journeys. There was a reduction in cycling, especially for those who drove in a cast, suggesting cyclists who broke their wrist changed to driving while their arm was in a cast. Information provision did not affect whether someone drove or not. Implications for providing travel information to help people avoid car use while their forearm is in a cast and maintaining behaviour change afterwards are discussed.

Keywords

Habit; driver behaviour; travel behaviour; behaviour change; injury

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1.Introduction

1.1. Premise

Major life events, including gaining or losing a driving licence, moving home, and starting a new job have been demonstrated to be associated with travel behaviour change (Klöckner and Matthies, 2004), and in particular mode switch due to weakened habits (van der Waerden, Timmermans, and Borgers, 2003). Williams et al (2013) suggest it is not just major life events but smaller disruptive elements that can effect travel behaviour change. The literature suggests that temporary events can change people's travel behaviour, such as road works and closures (Fujii & Gärling, 2003; Gärling & Axhausen, 2003), adverse weather (see Cools et al., 2010), natural disasters (Graham, 2009), the Olympic Games being held (Parkes et al., 2014) and protests that stop vehicles proceeding, such as the 2000 United Kingdom (UK) fuel price protests (Lyons and Chatterjee, 2002). Such changes to the flow or disruptions provide a specific opportunity to target and promote travel behaviour change (Jones and Sloman, 2003; Marsden & Docherty, 2013). This paper will examine how having a wrist in plaster that may hamper driving following a fracture is a temporary disruptive event that may lead to travel behaviour change.

1.2. Driving with the wrist or hand in plaster

Having the wrist or hand in plaster has the potential to disrupt habitual travel behaviour and can create a short-term cessation in driver behaviour. Previous studies suggest that between 9% and 50% of people continue to drive with their arm or wrist in a cast. Edwards et al (2009) in a postal survey carried out in the UK found 9% of 144 respondents admitted to driving a car or riding a motorbike with their wrist or arm in a cast. Kennedy et al (2006) found a slightly higher percentage, with 15% of 118 surveyed patients in Ireland with upper or lower limb casts continued to drive with their arm or wrist in plaster. Kalamaris et al. (2006) found 50% of Australian patients drove their vehicle after having their arm or wrist placed in a plaster cast. Interestingly in Edwards et al's (2009) study three of the 13 patients who were driving ceased on advice given during the project suggesting that they had not received advice prior to making their return to driving decision. Another patient stopped driving when his insurance company told him he was not insured. The east coast Australian study by Kalamaras et al (2006) found that two-thirds of the male participants who broke their wrist drove in a cast, compared to only one-third of females. The difference in the prevalence of drivers between the Edwards et al. (2009) and Kalamaris et al. (2006) studies may be due to the relative geographies and the social norms in the two countries with regards to the role of driving. There is little understanding of the motivations people have for driving or not driving while their arm or wrist is in plaster and how far psycho-social factors, such as affect or risk taking, may explain some of the differences. The affective side of driving has recently received more attention, with the notion that driving has socio-emotional aspects and is more than just about getting from A to B. Research suggests this might be explained by risk (e.g. Musselwhite, 2006) and may also be present in the affect shown towards the vehicle or the act of driving itself (e.g. Ellaway et al., 2003). How far these constructs determine whether someone finds it difficult to give-up driving, even temporarily, is useful to investigate.

Another factor that might affect whether someone drives in a plaster cast is information provision. However, research across a variety of countries suggests that health practitioners are reluctant to give advice to patients, largely due to the ambiguity in guidelines about returning to driving e.g. in

the UK (Nunez and Giddins, 2004; Von Arx et al, 2004; Edwards et al, 2009); USA (Chen and Jupiter, 2007; Chong, 2010); Australia (Kalamaras et al,2006); Netherlands (Haverkamp et al, 2005); and Ireland (Kennedy et al, 2006).

For those that continue to drive, previous research suggests that driving behaviour is made worse by the wearing of a plaster cast. It is unclear to what extent having an arm in a cast affects driver performance. Several studies indicate that the presence of a forearm cast on healthy volunteers does affect driving performance (Blair et al, 2002; Kalamaras et al, 2006, Gregory et al 2009, Chong et al, 2010). Gregory et al (2009) found that forearm immobilisation led to more cautious driving under normal conditions in terms of driving more slowly and adjusting speed and lateral position less frequently. This may be due to drivers perceiving the cast as an additional applied risk to their normal driving behaviour and their taking compensatory action (Adams, 2012; Wilde, 1998). All of these studies used low numbers of healthy volunteers on test tracks. No study to date has assessed self-reported safety of people who have actually broken their arm and are driving with their arm in plaster. This is important as pain, muscle de-conditioning, secondary stiffness and anxiety may impact on driving behaviour. These factors may be compounded by other co-morbidities, the side effects of treatments and the combined effects of aging, such as slowed motor function, altered proprioception, weakness, decreased endurance and visual and hearing disturbances.

1.3 Objective

This paper investigates the prevalence of driving with a wrist in a plaster in a sample of people with broken wrists in the United Kingdom and examines differences in background, risk and affect between those who drove and those who did not. It examines changes in travel behaviour during the period of having the wrist in plaster and whether provision of information has any influence on whether someone drove or not. Research has not to date examined travel behaviour change in light of such a disruption and has not provided any detail on whether there are any background or attitudinal differences on those who drive compared to those who do not.

Specifically this paper sought to examine the prevalence of drivers and examine the background details of drivers compared to non-drivers; are there significant differences in age between drivers and non-drivers with regards to age, gender, miles driven per week and length of time in a plaster cast, for example? In addition, can whether someone drives in their plaster or not be predicted from their attitudes to risky driving or driving affect? The paper also looks at the role of information provision on whether someone drove or not. Finally, it looks what changes are made to travel behaviour in terms of miles, journeys and mode, while the wrist is in plaster.

2.Methodology

2.1 Design

A questionnaire was sent to participants who had broken their wrist and had had their forearm and wrist in a plaster cast, to assess how it had affected their travel behaviour. For those who choose to drive, the questionnaire also assessed how their driving behaviour was affected. The questionnaire format was used to help ensure participants anonymity, which helped with validity in terms of alleviating potential concerns that participants might have that they were driving illegally with a cast, as had been found in previous literature (Edwards et al., 2009), while reaching a large number of

participants. It is important to reach a large number of participants in order to capture enough people who will drive with their cast on; as previous literature suggests that it may be as few as only around 9% of the population drive with a fractured wrist (Edwards et al., 2009).

2.2 Participants

Participants were selected from patients who had broken their wrist and had had their forearm in a plaster cast and were visiting an Orthopaedic Trauma clinic in a large hospital based in the United Kingdom to have their plaster casts removed. Patients were only selected if they had a distal radial fracture which had been treated in a below elbow cast and had received no surgery. Patients who met these criteria were then telephoned by the researcher and asked if they would complete a questionnaire; those who agreed were then sent a questionnaire to complete. A total of 111 participants took part of which 87 were female and 24 male, only three people declined to take part. The average age of the sample was 57.08 years and met the criteria for normal distribution around a mode of 62 years. Females were slightly older than males, although the difference was not statistically significant (female=58.38 years; male=52.38 years; $t(109)=1.87$; $p=0.064$; $d=0.43$). In relation to handedness, 97 were right handed, 10 left handed and 4 were ambidextrous. The majority of patients (77) were injured in a fall from standing height or less and 17 were injured in a fall from greater than standing height. Ten injuries were related to sporting activity, two were from road traffic accidents and five were from other causes (e.g. a variety of work accidents or leisure pursuit accidents). The left wrist was most commonly injured (66) with the right wrist injured 43 times and 2 patients injured both hands. Participants had their casts on for between one and twelve weeks with the median time being 6 weeks (48.6% of participants) and the average being 5.5 weeks. The sample had held a driver licence for an average of 32.62 years. On average, the participants drove 82.62 miles in a typical week, though distribution was skewed more to the lower number of miles. Males drove significantly more miles (139.58 miles/week) on average per week than females (67.72 miles/week) ($t(26.08)=2.47$; $p=0.020$; $d=0.66$). There was a significant negative correlation between age and miles driven per typical week ($r=-0.19$; $n=111$; $p<0.05$), the younger the driver, the more miles they drove.

2.3 Procedure

Participants were asked by the plaster technician if they would like to take part in a research project examining their travel and driving behaviour during the time they wore a plaster. Those that agreed gave their telephone details and a researcher then telephoned them to answer any questions about the research and obtain their informed consent. Those agreeing had the questionnaire posted to them along with instructions and a pre-paid envelope to send it back. A telephone call was made to non-responders after 4 weeks. The response rate at this stage was 63%. Returned questionnaire data was entered onto a spreadsheet and then analysed using SPSS (Version 20).

2.4 Tools

Baseline descriptive information on demographics of the patient (e.g. age, gender, hand dominance, occupation, nationality), fracture management (e.g. mechanism of injury, treatment, number of weeks in a cast, which arm in a cast, cast description, problems with activities of daily living in the cast) and past medical history (e.g. co-morbidities) was collected using the questionnaire. General

driving information (number of years of full driving licence, type of vehicle transmission, rural, urban or mixed roads), self-reported travel behaviour (usual distance travelled and modes of transport and how much this had changed since having wrist in a cast) and cast driving behaviour (e.g. whether they drove in a cast, if so, how often and whether they felt safe) were also collected. How much information they received about driving in a cast and who gave it was also collected. The questionnaire incorporated the Driver Risk Survey (Musselwhite, 2006), to identify driver behaviour in relation to risk taking and the psycho-social relationship of driving and travel behaviour was collected using questions from Ellaway et al. (2003) to assess the level of affective and emotive identity participants had with driving and cars.

2.5 Analysis

Descriptive statistics were used to explore background information about the sample, including how breaking an arm and having it in a cast affected travel behaviour. Inferential analysis was conducted to identify the characteristics of those who drove compared to those who did not drive with their arm in the cast. This included examining risk taking behaviour using Musselwhite's (2006) driver risk survey and affect using Ellaway's et al (2003) driver habit scale and whether or not this was felt to be safe.

Due to the large number of analyses conducted within this study corrections were made to reduce the possibility of type I error occurrence. While Bonferroni corrections (Dunn, 1951) are commonly used as a means of correction, the Holm-Bonferroni method was chosen in this instance. The Holm-Bonferroni method (Holm, 1979) is a more sophisticated adjustment and is considered superior (Aickin and Gensler, 1996).

The adjustment made is dependent upon the number of hypotheses being tested. For example, where t-tests were conducted which compared means of attitudes scores by gender, the number of attitudinal scores (dependent variables) was used as the number of hypotheses which had to be adjusted for. Thus in that instance the adjustment was made based upon 16 dependent variables. Similarly where attitude scores were compared between older and younger participants adjustment was made for 16 hypotheses. This method was chosen due to different constructs being tested, rather than simply adjusting for 32 hypotheses.

3. Findings

3.1. Prevalence of driving in a plaster cast

Twenty-one participants chose to drive while their wrist was in a plaster cast representing 18% of the study population. These included the youngest participant (21 years old) and the oldest participant (85 years old). The average age of participants who drove with a cast on was slightly younger (53.38 years) compared to those who did not drive (57.94 years), though the difference was not significant ($t(109)=1.342$; $p=0.183$; $d=0.29$). Those who continued to drive with their cast were those who ordinarily (i.e. when not in a cast) drove higher miles on average (mean average 104.05 miles) than those who did not drive in a cast (mean average 78.41 miles), but this difference was not statistically significant ($t(109)=1.155$; $p=0.251$; $d=0.24$). Nine of the 24 (37.5%) male participants drove, compared to only 12 of the 87 (13.79%) female participants. Males were significantly more

likely than females to drive in a plaster cast(x^2(1. 111) = 6.89; p=0.009; r=0.25). The length of time the arm had been in plaster did not affect whether someone drove or not; those who drove had had the plaster on for an average of 5.38 weeks and those that did not drive for an average of 5.53 weeks (t(109)=0.501; p=0.617; d=0.13). Hence, the only significant difference between those who drove and those who didn't in terms of background data, was that males were significantly more likely than females to drive with their wrist in plaster.

Of the 21 participants who drove with a cast, 15 stated they drove less frequently than normal (with 11 of these driving far less frequently). Five people stated they continued to drive the same amount and one person stated they drove more frequently.

3.2. Self reported driving safety with a wrist in a plaster cast

On the whole, people who drove with a cast stated that they thought it was safe to do so, though there was greater admittance to feeling uncomfortable they did not feel that this negatively affected their observation, skills or safety (see table 1). It was also common for people to use compensatory behaviours to help them drive with an arm in a cast (see table 1).

Did driving in a cast alter driver behaviour? 1= strongly disagree through to 7=strongly agree					
	N	Min	Max	Mean	SD
Observational skills worse in cast	21	1	7	1.57	1.54
Cast made driving more dangerous	21	1	7	2.38	1.91
More risky driver with arm in cast	21	1	7	2.67	2.03
Steering was more difficult with arm in cast	21	1	7	3.52	2.38
Cast made driving uncomfortable	21	1	7	3.81	1.94
Easy to drive in cast	21	1	7	4.19	2.04
Easy to change gear	20	1	7	4.35	2.39
More difficult to do manoeuvres	21	1	7	4.71	2.19
Total control with arm in cast	21	1	7	5.48	2.06
Used compensatory behaviours	21	1	7	5.52	1.78
Safe to drive with arm in cast	21	2	7	5.86	1.62

Table 1: Self-reported changes in driver behaviour as a result of wearing a forearm plaster cast

Sixteen of the 21 participants thought that they had made the right choice to drive, with 11 of these stating the highest level of agreement. Five people stated that they disagreed they had made the right choice, with three of these stating this very strongly.

3.3. Driver risk and driver affect and driving with a wrist in a plaster cast

The Driver Risk Survey (Musselwhite, 2006) was completed by all participants (see table 2). On the whole participants tended to show safe driver behaviour, with the most frequently reported risk behaviour being the realisation that you are driving faster than you think so needing to slow down. This was followed by being in a hurry to get somewhere and feeling 30mph should be a 40mph speed limit. There were significant differences between males and females; males were more likely

to report more frequently engaging in risky behaviour with regards to feeling a 30mph should be a 40mph (t(109)=2.48; p=0.015; d=0.57), performing fast acceleration and deceleration if late (t(109)=2.47; p=0.015; d=0.52)and risky overtaking ordinarily (t(24.05)=2.10; p=.046; d=0.59) but not if (t(26.289)=1.69; p=.102; d=0.45). In terms of differences in age, the sample was sub-divided at the median point of58 years; those aged 58 and below were labelled "younger" and those aged 59 and over labelled as "older". There were many examples of risky behaviour that younger participants performed significantly more often than older participants including being in a hurry to get somewhere (t(109)=2.82; p=0.006; d=0.54), driving fast as feels safe to do so (t(101.9)=2.67; p=0.009; d=0.52), when in a hurry (t(109)=2.95; p=0.004; d=0.56) and when angry (t(99.25)=2.72; p<0.008; d=0.52), using heavy acceleration and braking ordinarily (t(87.80)=4.11; p<0.001; d=0.79) and if late (t(79.12)=3.88; p<0.001; d=0.75), driving close to the vehicle in front if late (t(79.182)=3.12; p=0.003; d=0.61) and driving fast even when it feels unsafe to do so (t(67.45)=3.89; p<0.001; d=0.75)

Behaviour (1=never to 7=very often)	N	Mean	SD	Significant gender or age differences
Driving faster than thought so slow down	111	6.23	1.4	
Realise driving faster than thought	111	3.77	1.54	
In a hurry to get somewhere	111	3.41	1.46	Younger (<59 years) (3.81) significantly higher than older (59=+) (3.05) (t(109)=2.82; p=0.006; d=0.54)
Feel 30mph should be 40mph	111	3.29	1.72	Males significantly. higher (4.04) than females (3.08) (t(109)=2.48; p=0.015; d=0.57)
Drive faster as feel safe to do so	111	2.50	1.54	Younger (<59 years) (2.91) significantly higher than older (59=+) (2.14) (t(101.9)=2.67; p=0.009; d=0.52)
Drive faster when in a hurry	111	2.30	1.48	Younger (<59 years) (2.72) significantly higher than older (59=+) (1.91) (t(109)=2.95; p=0.004; d=0.56)
Use different lane to get ahead	111	2.16	1.46	
When late use different lane to get ahead	111	2.15	1.44	
Drive faster if angry	111	1.94	1.38	Younger (<59 years) (2.3) significantly higher than older (59=+) (1.6) (t(99.25)=2.72; p=0.008; d=0.52)
Use fast acceleration / heavy braking if late	111	1.92	1.24	Males significantly. higher (2.46) than females (1.77) (t(109)=2.47; p=0.015; d=0.52)* Younger (<59 years) (2.38) significantly higher than older (59=+) (1.5) (t(79.12)=3.88; p<0.001; d=0.75)
If late then drive close to vehicle in front	111	1.69	1.19	Younger (<59 years) (2.06) significantly higher than older (59=+) (1.36) (t(79.182)=3.12; p=0.003; d=0.61)
Use fast acceleration / heavy braking	111	1.63	0.9	Younger (<59 years) (1.98) significantly higher than older (59=+) (1.31) (t(87.80)=4.11; p<0.001; d=0.79)
Drive faster if car is close behind	111	1.61	1.07	
Drive faster than speed limit even though feels unsafe	111	1.43	0.91	Younger (<59 years) (1.77) significantly higher than older (59=+) (1.12) (t(67.45)=3.89; p<0.001; d=0.75)
Perform dangerous overtaking if late	111	1.39	0.95	
Perform dangerous overtaking	111	1.32	0.84	Males significantly. higher (1.83) than females (1.17) (t(24.05)=2.10; p=.046; d=0.59)* Younger (<59 years) (1.55) significantly higher than older (59=+) (1.10) (t(59.93)=2.75; p=0.008; d=0.54)

Table 2: Driver risk survey results (after Musselwhite, 2006) including significant differences by gender and age.

Agree (1=never to 7=very often)	N	Mean	SD	Significant gender or age differences
Driving helps me get from A to B	111	6.64	.90	
Driving makes me feel independent	111	6.32	1.43	
I am a very safe driver	111	5.91	1.18	
I feel in control when I drive	111	5.77	1.47	
If I couldn't drive life would be extremely inconvenient	111	5.41	1.90	
Driving keeps mind active	111	5.21	1.84	Older participants significantly higher response (5.57) than younger participants (4.41) (t(109)=-2.211, p=.029; d=0.42
Without driving I could not fulfil activities	111	4.99	2.07	
Not being able to drive makes me feel isolated	111	4.99	2.16	
I love to drive	111	4.97	1.77	
When I drive I feel a sense of accomplishment	111	4.76	1.98	
Most people should drive like I do	111	4.71	1.61	
I feel very safe on the roads	111	4.54	1.76	
Driving is part of who I am	111	4.33	2.16	
My driving style reflects my personality	111	4.31	2.06	
Driving makes me feel good about myself	111	4.16	2.12	
I feel safe from the risk of crime when I drive	110	4.03	1.89	
When I drive it makes me feel I'm doing well in life	111	3.94	2.03	
I feel attached to driving	111	3.86	2.22	Males significantly higher response (4.79) than females (3.61) (t(109)=-2.356, p=.020; d=0.51)
Driving says something about my personality	111	3.86	2.02	
I can get away from the stresses of life when I drive	111	3.82	2.12	
I feel safe from other traffic when I drive	111	3.53	1.92	

Table 3: Driver habit survey (after Ellaway et al., 2003) results including significant differences between gender and age.

The Driving Habits Questionnaire which is a measure of driver affect (Ellaway et al., 2003) was completed by the participants, see table 3. After Holm-Bonferroni adjustments all elements of this questionnaire remained non-significant except older drivers compared to younger drivers are significantly more likely to say driving keeps their mind active ($t(109)=-2.211$, $p=0.029$; $d=0.42$) and males compared to females are significantly more likely to state they are attached to driving ($t(109)=-2.356$, $p=0.020$; $d=0.51$).

There were no significant differences between the any of the factors on the Driver Risk Survey and whether someone drove or not. Therefore, driver risk does not influence whether someone drivers in a cast or not. Similarly, there were no significant differences between the variables found on the Driver Habit Survey and whether someone drove or not. Therefore, driver affect is not related to whether someone drives in a cast or not.

A logistic regression predicting driver continuation while in a cast was run for both questionnaires. The attitudinal items from the Driver Risk Survey (after Musselwhite, 2006) and the Driver Habit Survey (after Ellaway et al., 2003) were entered as predictors into a logistic regressions predicting whether or not participants reported driving while in a cast. The test of the model against a constant only model failed to produce statistically significant results indicating that the attitudinal items did not reliably predict whether or not individuals chose to drive while in a cast (chi square = 19.421, p= .558 with df = 21).

3.4. Changes in travel behaviour as a result of having a wrist in a plaster cast

People reported that breaking their arm and having it in a cast reduced their miles and had some effect on reducing their cycling (for those that did). There were large increases in the use of the train and bus and in walking, with some increase in lifts from friends and family. Even though miles were reduced, the total number of journeys taken increased; suggesting wearing a plaster-cast reduces the ability to do multiple things at the destination or has created more need to do distributed journeys.

Changes in amount and mode of travel when the arm is in plaster are shown in table 4. The overall number of miles travelled reduced dramatically when someone had their arm in plaster, and this was the case whether they drove with a plaster on or not, with no significant differences found ($t(109)=0.05$; $p=0.96$; $d=0.01$). The number of journeys taken in total increases, especially for those who did not drive in a plaster cast who take a significantly higher number of journeys than those who drove in a plaster cast ($t(23.1)=3.12$; $p=0.005$; $d=0.86$). Highest increase in use across all modes was using the train, followed by using the bus and walking. Using a bus and train saw no significant differences between those who drove and those who did not, both increasing their use of these modes by around the same amount. But, those who did not drive increased their walking significantly more than those who did drive ($t(24.8)=2.27$; $p=0.032$; $d=0.61$). Taking lifts with family and friends increased for non drivers and decreased very slightly for drivers and the difference between the two groups is significant ($t(109)=2.61$; $p=0.01$; $d=0.58$). Those who did not drive also increased their train use more than those who drove but the difference is not significant ($t(24.1)=1.65$; $p=.112$; $d=0.45$). Also, people who normally cycled reverted to using the car and cycling was significantly reduced for those who drove in their cast, compared to only a very small change for those that did not ($t(41.9)=3.61$; $p=0.001$; $d=0.78$).

Effect on journeys: Scale from 1=high decrease to 7=high increase; 4=no effect)	Mean (SD)	Drove while in cast	N	Mean	Std. Deviation	Significant difference between drivers in a plaster cast and non-drivers
1. Total miles travelled	1.73 (1.56)	No	90	1.73	1.57	
		Yes	21	1.71	1.52	
2. Cycling	**2.79 (1.96)**	**No**	**90**	**3.04**	**1.99**	**t(41.9)=3.61; p=0.001; d=0.78***
		Yes	**21**	**1.71**	**1.38**	
3. Lifts with friends/family	**4.51 (1.79)**	**No**	**90**	**4.72**	**1.66**	**t(109)=2.61; p=0.01; d=0.58***
		Yes	**21**	**3.62**	**2.09**	
4. Walking	**5.29 (1.77)**	**No**	**90**	**5.51**	**1.57**	**t(24.8)=2.27; p=0.032; d=0.61**
		Yes	**21**	**4.33**	**2.24**	
5. Using a bus	5.78 (1.6)	No	90	5.90	1.48	
		Yes	21	5.29	2.00	
6. Total journeys taken	**5.86 (1.74)**	**No**	**90**	**6.18**	**1.37**	**t(23.1)=3.12; p=0.005; d=0.86***
		Yes	**21**	**4.48**	**2.42**	
7. Using a train	5.95 (1.5)	No	90	6.10	1.32	
		Yes	21	5.33	2.03	

Table 4: people's self-reported changes in use of modes when arm was in plaster (1=much less/fewer through to 7=much more; significant differences in bold)

For those who did not drive, 52 out of 91 (57.2%) agreed or very much agreed (scored 6 or 7 on a scale from 1 very much disagree to 7 very much agree) with the statement, "when in a cast I couldn't wait to drive again" (see figure 1). However, 16 (17.6%) participants stated they very much disagreed or disagreed (scored 1 or 2 on the scale) with the same statement.

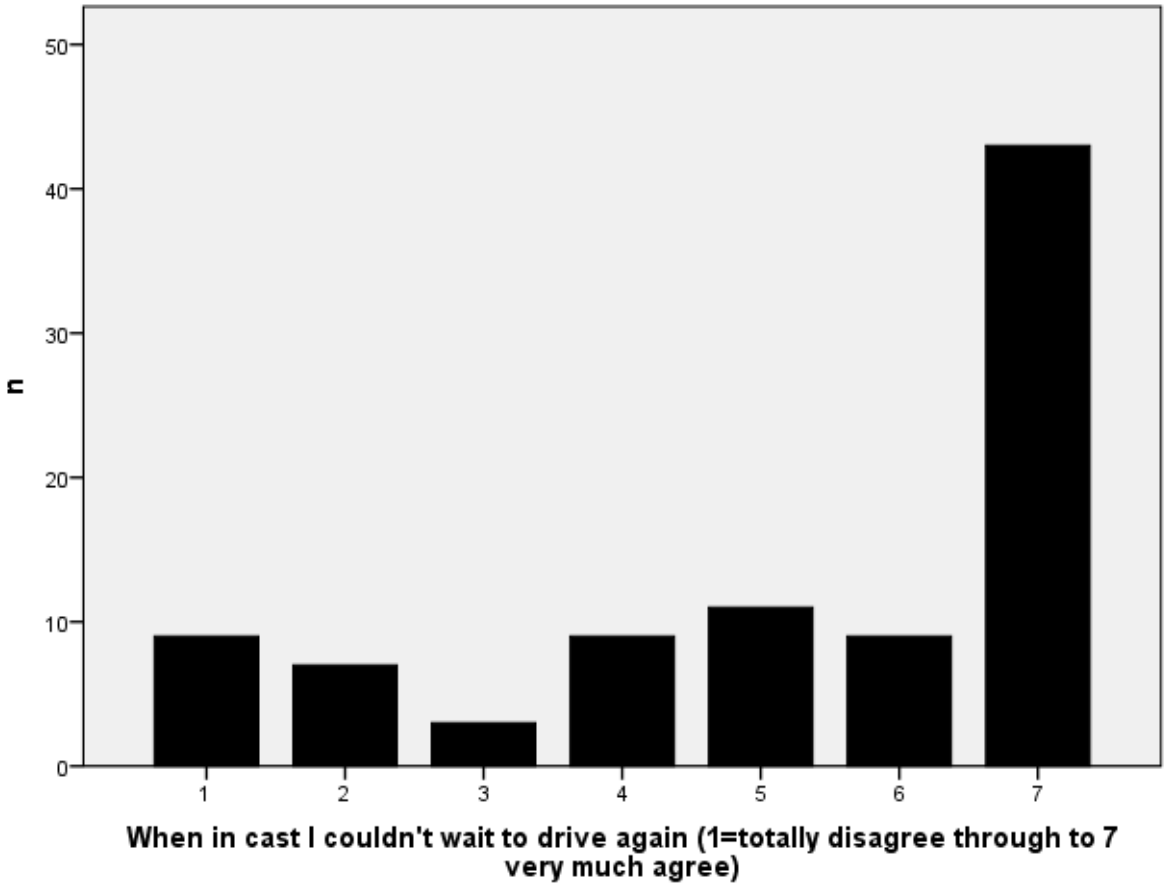

Figure 1: Ratings of agreement among non-driving participants with regards to the statement, “When in a cast, I couldn’t wait to drive again”

3.5. Information provision and driving in a plaster cast

A total of 53 of 111 (47.75%) participants received advice on whether to drive or not, 27 sought information themselves (independently approached a professional or friend or family member)(24.32%), 8 received information directly (7.21%) and 18 both sought and received information (16.22%). Whether or not someone had information did not seem to influence driving: of the 21 people who drove, 11 received no information while 10 obtained information. However, this was not evenly distributed amongst how information was sought, 4 of the 18 (22.22%) who sought information drove, 1 of the 8 (12.5%) who were given information drove and 5 of the 18 (27.78%) who sought information drove.

Information sources and types of information given for those that sought advice are presented in table 5. Overall 11 people drove who were told not to, 7 of those by medical professionals (5 approached a medical professional and 2 were told). Information provision did not influence whether someone drove or not, even if the information given was “not to drive”. Further research is needed as to why this may be the case. If the information “not to drive” came from a doctor or plaster technician then this seemed to have a stronger effect on a person not driving but with such small numbers these conclusions have to be made tentatively. In six dealings with insurance

companies, three advised the individual it was up to them, three advised participants not to drive (of which one person still went ahead and drove.)

Information sought from	**Approached for information**	**Was told...Don't Drive(of which ended up driving**	**Advice given**	**Was told...Don't Drive(of which ended up driving)**
Doctor	22	16 (2 drove) 12.5%	7	7 (1 drove) 14.29% drove
Nurse	10	5 (1 drove) 20%	2	1 (1 drove) 100% drove
GP	2	2 (1 drove) 50%	0	0
Plaster Technician	11	9 (1 drove) 11.11%	4	2 (0 drove) 0% drove
Other medical person	4	2 (0 drove) 0%	2	2 (0 drove) 0% drove
All health combined	**45**	**33 (5 drove) 15.15%**	**17**	**12 (2 drove) 16.67%**
Family and friends	11	9 (2 drove) 22.22%	14	8 (1 drove) 14.29% drove
Insurance company	6	3 (1 drove) 33.33%	0	0
Total: told do not drive	**66 sources from 45 people (1.47 sources/person)**	**46 (8 drove/38 didn't) 17.39% drove**	**29 sources from 26 people (1.12 sources/person)**	**20 (3 drove/17 didn't) 15% drove**
No information	**58 people had no information**	**58 (11 drove/47 didn't) 18.97%**		

Table 5: Information source and advice whether to drive and whether people actually drove in a plaster cast.

4. Discussion

Eighteen percent of the sample that reported driving while having their arm in a cast represented a range of people, especially in terms of age and mileage driven, where there was no significant difference to those who did not drive. Males are more likely than females to drive with a plaster cast on, which is similar to previous research (Kalamaras et al., 2006), although the figures were far lower in this study. With no significant difference in mileage between drivers and non-drivers, the higher prevalence of driving in men perhaps relates to norms and expectations within society and a lack of willingness to change mode. Previous studies have suggested that females are more multi-modal (Siren and Hakamies-Blomqvist, 2005; DfT, 2010) and driving is seen as a masculine pursuit (e.g. Rothe, 2004). Kalamaras found that 50% had driven in their cast, perhaps a reflection of differences between cultures in terms of car dependency or norms with regards to driving, though general use on car statistics between the two countries suggests a similar level of usage with both having averages around 14,000km per vehicle per year (DfT, 2012, ABS, 2012), though this does vary by

region, especially in Australia. The findings here also see an increase on the 9% found in the previous study of British drivers who drove in a cast (Edwards et al., 2009).

The research attempted to address whether drivers who displayed higher risk while driving and those that displayed higher affect with their vehicle would be less likely to resist driving while in a cast. However, the was not found to be the case and participants who drove were similar to those that did not drive in terms of risky driving behaviours and affect for vehicles and driving. This suggests the need to drive is almost certainly being motivated by social norms and utility or perceived necessity, rather than by risk or adoration for driving. Hence, attempts to stop people driving while in their cast need to help people with completing journeys they would normally do in a practical manner, rather than concentrating on psychosocial elements such as risk or affect. In addition, what is expected of them given how they view how others might behave, the social norm, is worth investigating further in the context of driving in a plaster. For some, it could be argued the social norm of driving is still present even when encumbered by a wrist in plaster. Strategies aimed at providing information on alternative travel choices could be presented, including local bus timetables and walking routes, perhaps utilising personalised travel planning strategies, tailoring solutions to individuals. In addition, making other modes more socially acceptable or making driving with a wrist plaster cast unacceptable need further exploration.

Eighty-two percent of participants choose not to drive with their arm in a cast over a period of approximately five to six weeks. This demonstrates that changes can be made to daily travel patterns. Noticeably, the number of miles travelled is reported to dramatically decline for those in a cast, whether they drove or not, though the number of journeys made increased, especially for those that did not drive. This perhaps indicates how the car enables individuals to travel to areas where multiple tasks can be performed and when relying on other transport or lifts, this changes to having to access multiple centres for the same tasks to be completed. Cycling is reduced amongst the participants for the time their arm is in plaster, this is especially true for those that drove while in a cast, suggesting many of those driving in a plaster cast are usually cyclists. Perhaps people have a hierarchy of transport use, perhaps based on social norms, where the default transport is displaced incrementally to the next level, those who normally cycle take to driving and those that normally drive change to walking or public transport. Using the bus and train increases for both drivers and non-drivers. Walking increases for both, but more significantly for non-drivers. Lifts with family and friends increases for those who had not driven in a cast, but fall slightly for those in a cast. Why this should be needs further investigation, do some people feel a burden and would rather drive than get a lift? Perhaps the end destination is no longer accessible or desirable for someone in a cast, so trips with others to such places are reduced? The findings may be very different if people did not view their situation as temporary. Further qualitative work would bear some of this out but findings tentatively suggest some of the changes in travel behaviour may be difficult to sustain over a long period of time. An increase in trips as a passenger suggests a burden that may not be sustainable if the change in travel behaviour was more permanent; older people who give-up driving often feel a burden to those having to give them lifts (Musselwhite & Haddad, 2010; Musselwhite & Shergold, 2013). The increase in the number of journeys made against a reduction in mileage suggests increased inconvenience of travel without the car, again how far this is sustainable beyond a short period of enforced change is questionable.

So, the breaking of an arm for the majority does change travel behaviour and does have the potential to disrupt habit, however, the majority could not wait to get back to using the car and strategies to lock in behaviour change are evidently needed. Yet, there was a significant number for whom the looming necessity to get behind the wheel of a car again was seen negatively. There is real potential to help these people with behaviour change. It is therefore felt with the right intervention in place then the temporary disruption to driving caused by having a wrist in plaster could act as a trigger for travel behaviour change akin to. There is a need to lock in such change so as not to revert back to the social norm of driving (Avineri and Goodwin, 2010), otherwise temporary disruption to driving does not see the long-term changes that are associated with major life events.

The self-report nature of the travel behaviour data could be enhanced with GPS technology to improve reliability and validity. It is hard to have such data for periods prior to breaking an arm (though future "big data" projects may have large numbers of traceable GPS data collected), but for periods after it is possible to collect data from mobile phones or equip people easily. Algorithms help discern mode and accuracy is increased from self-report (e.g. Houston et al., 2014; Huss et al., 2014).

With regards to driving safety, people who did drive reported that they felt very safe and felt that wearing a cast made little difference to their observation skills, steering or comfort. Ability to perform manoeuvres was reported to be more of an issue and it was also reported that compensatory behaviours were used, though what these were have not been collected in this study. This project has a limitation here in that self-reported safety is examined and pressures of reporting favourably are probably quite high given concerns for potential repercussions of dangerous driving. Further research using observational methods and data recording of actual drives, observing more objective data alongside interviews to capture motivation and feelings, would be useful and would add to the laboratory or test track style studies carried out previously.

Information provision made little difference to whether someone drove or not, even when they were told not to drive. Doctors and plaster technicians were more likely than nurses and other medical professionals to advise participants not to drive, though the influence of fracture severity and other individual factors that medical practitioners may take into account are not included here. Hence, it is difficult to say whether the profession makes a difference or the person presenting to them. Findings suggest that there is little pattern with regards to information provision and driving outcome, perhaps because it does not form a coherent narrative between people and incidents and between different professional groups and private individuals. Information provision intervention studies could be improved in the future through randomised control trials of different information provision, especially with regards to messenger which seems important from this preliminary scoping taken place in this project.

Previous research suggests trust in the message and messenger is important for compliance in transport road safety and delivery of schemes (e.g. Gaunt et al., 2007; Viegas and Macario, 2003). There is a view that normative relationships, trust and shared values between individuals and within social groups can contribute to the success of behaviour change initiatives such as travel behaviour change (Avineri and Goodwin, 2010). Where the message on whether to drive or not is ambiguous as is found here, the findings suggest trust becomes a localised issue based around social norms. Hence, any behaviour change associated with small scale disruptions require a consistent top-down

approach in the change of rules and laws to enforce change or require bottom-up grass-root level change among social groups of similar backgrounds. Group work encouraging behaviour change through travel behaviour planning is an example of the latter and could be used with success in establishing and locking-in behaviour change following a broken wrist.

5. Conclusion

Overall, this research develops our understanding of driving while in a below elbow cast and suggests that those who do drive reflect a variety of backgrounds, although males are more likely to drive in a plaster cast than females. It suggests that people who do drive feel safe and use compensatory behaviours, though what these are, and how good people are at judging their own safety, needs further research. When people drive in a plaster cast, it appears that they are driving mainly for practical reasons and that it fits established social norms, since risk taking and affect are not predictive of whether someone drives or not in a cast. Hence, it would seem people are driving out of necessity. That said, many manage to find other ways of getting by without using their cars, albeit temporarily, with many wishing to get back to driving as soon as possible. How to lock in some of the change that occurs and assessing the positive or negatives of the changing travel behaviour for the individual needs more research. About half the sample had no information on whether to drive or not, though those that did seek information and were told not to drive are no less likely to drive than those who are told that it is up to them or have no information. It is suggested that any material developed to inform the decision to drive or not should concentrate on helping people reflect on the necessity of the journey. It could, for example, introduce information on alternative forms of travel behaviour, perhaps at an individual level, as in personalised travel planning, and this may help lock-in changes when the person has their plaster cast removed.

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